Introduction to Integrated Chiller Retrofits

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Why an Integrated Chiller Retrofit?

- **Turn the necessity of coping with CFC phaseouts into an opportunity for**
  - **Energy & Cost Savings**
  - **More Efficient Building Operations**
  - **Improved Environmental Sustainability**
  - **Increased Comfort and Productivity**
  - **Increased Asset Value**

What is an Integrated Chiller Retrofit?

- **Combines**
  - **building system and load improvements/retrofits**
  - **chiller replacement or retrofit for CFC conversion**
- **Systems approach for comprehensive building analysis**
  - **solves building problems**
  - **saves energy and money**
  - **finances chiller replacement with other measures**
  - **deals with CFC issues**
  - **avoids lost opportunities**

Steps to an Integrated Approach

- Find operations & maintenance opportunities
- Look for building load reductions
- Use low or no-energy HVAC systems
- Introduce high-efficiency equipment
- Improve control systems
- Properly commission the systems

Operation & Maintenance Opportunities

- **Audit to find efficiency opportunities**
  - **Check equipment condition and function**
  - **Evaluate operating schedules**
  - **Evaluate temperature setpoints**
  - **Evaluate problems**
- **Typical energy savings due to O&M improvements is 10% or more**

Reduce Building Loads

- **Building envelope**
  - insulation, glazing, outside surface reflectivities
- **Lighting loads**
  - high efficiency lighting, daylighting, controls
- **Plug loads**
  - appliances and their use schedules
- **Watch out for load assumptions**
  - measure, don’t assume!

Low or No-Energy HVAC Systems

- Cooling with economizers
- Direct and indirect evaporative cooling
- Heat recovery
- Natural ventilation
- Thermal Storage

High Efficiency HVAC Equipment

- **Energy-efficient equipment**
  - **Variable Speed Drives**
  - **Coils**
  - **Motors**
  - **Low kW/ton chillers**
- **Avoid oversizing**
  - **saves initial and lifetime costs**

Improve Control Systems

- Must be properly commissioned and used
- Get training over an extended time period
- Get manuals specific to your system
- Periodically re-evaluate use of control systems

Commission the Systems

- **Save time, energy, aggravation, and even litigation over the building lifetime**
  - **Pre-functional testing**
  - **Functional testing of systems**
  - **Training, manuals**
  - **Re-commission older systems if needed**

Chicago Office Building Example
Project Context

- CFC refrigerants in existing chillers
- Desire to reduce utility bills
- Comfort complaints, “not enough air”
- Perceived need to purchase new 200 ton chiller

Chicago Office Building Example
Project Steps

- **Audit**
- **Implementation**
  - **low and no-cost measures implemented first**
- **Results**
  - **Operational**
  - **Financial**
  - **Non-financial**

Chicago Office Building Example
Building Load and System Improvements

Integrated Options	Estimated Initial Cost ($)	Estimated Annual Energy Savings ($)	Simple Payback (years)
Lighting Retrofits	$400,000	$137,000	2.9
Air Handling System Recommissioning	$71,000	$140,000	0.5
Central Cooling System Improvements	$4000	$10,000	2.5
Total	$475,000	$287,000	1.7

- **Even without chiller replacement**
  - Air supply problems resolved
  - Reduced chiller operation
  - Hot and cold complaints minimized

Chicago Office Building Example
Chiller Options

Chiller Options	Estimated Initial Cost ($)	Estimated Annual Energy Savings ($)	Simple Payback (years)	Payback w/ Improvements (years)
Add Supplemental 200 ton Chiller	$200,000	---	∞	---
Retrofit Existing Chillers for CFC Compliance	$100,000*	---	∞	---
Retrofit and Downsize Existing Chillers	$100,000*	$20,000*	5.0	1.9
Replace Existing Chillers for CFC Compliance	$450,000*	$25,000*	18.0	---
Replace and Downsize Existing Chillers	$400,000*	$30,000*	13.3	2.9

- "Back-of-the-envelope" estimates
- **Integrated load and system improvements reduce payback periods**

Chicago Office Building Example
Future Opportunities

- **No supplemental chiller needed**
  - **Avoided costs of $200,000 by making building load and system improvements**
- **Potential to reduce chiller capacity in combination with building retrofits**
- **Replacement and/or retrofit of chiller for CFC compliance**

Results of the Integrated Approach

- Saved energy and money from building system and load improvements
- Smaller chiller needed
- New, more efficient chillers add to savings
- Chiller work can be financed by measures with shorter payback periods
- Building operation and maintenance improved
- Building comfort and asset value enhanced